Space Weather Technical Forecast

Issued on Friday, 14 October 2022 at 01:17 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Decreasing chance of M-class flares. Active electron Fluence.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Moderate, with a long period M1.5 flare observed from AR3112 (Eso/Beta) along with a couple of C-flares. AR3112 has shown some simplification as it approaches the western limb, and losing its easternmost spots. AR3116 (Hax/alpha) to the north of this region, remains a simple unipolar region, whilst a small unnumbered spot temporarily appeared to the south of AR3112. C-flaring was also observed from AR3119 Dai/Beta, also in the northwest quadrant, although this region is a smaller than AR3112. The remaining numbered region is AR3121, a small, weak and magnetically simple region in the northeast quadrant. There are also a number of filaments on the Earth-facing disc, one of which erupted in the southern centre disc around 13/0650 UTC, but is not expected to be Earth directed.

Solar Wind / Geomagnetic Activity: The solar wind speed, as observed at L1, for much of the day was steady around 300 km/s, after erratically easing from around 380 km/s. However, in the evening a temporary increase occurred, with a peak speed of 448 km/s occurring at 13/2010. Density persisted at below average values. The total IMF strength, Bt, has been weak at below 6nT, with the north-south component, Bz predominately negative but also weak. The phi angle was mostly positive (away from the Sun). Geomagnetic activity was Quiet (Kp 0-2).

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) as measured at GOES16, has remained at background levels despite the M1.5 flare occurring in a geo-effective position. High energy electron flux (greater than 2MeV) was predominately at high levels, peaking at 4331 pfu at 13/1925 UTC, then decreased to Moderate levels from 13/2255 UTC. The associated 24-hour fluence has been above the Active (1e8 integrated pfu) threshold throughout but with a gradual declining trend since midnight. The 14/0000 UTC observation was 1.75e8 integrated pfu.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is forecast to be Low to Moderate with an ongoing but decreasing chance of M-flares, primarily from AR3112 but potentially also from AR3119.

Solar Wind / Geomagnetic Activity: Overall Earth will continue with solar winds at background levels. However, there is a slight chance of minor enhancements today and tomorrow from either a weak CME that has a small chance of giving a peripheral influence as it passes Earth, and also from the arrival of a weak HSS. In addition there is also a slight chance of another weak CME brushing Earth on the 17th, from yesterday's southern hemisphere filament eruption, but this CME is most likely to miss Earth. Geomagnetic activity will be mainly Quiet (Kp 0-2) but with isolated Unsettled (Kp 3) intervals, perhaps increasing to Active (Kp 4) with any fast wind or CME arrival.

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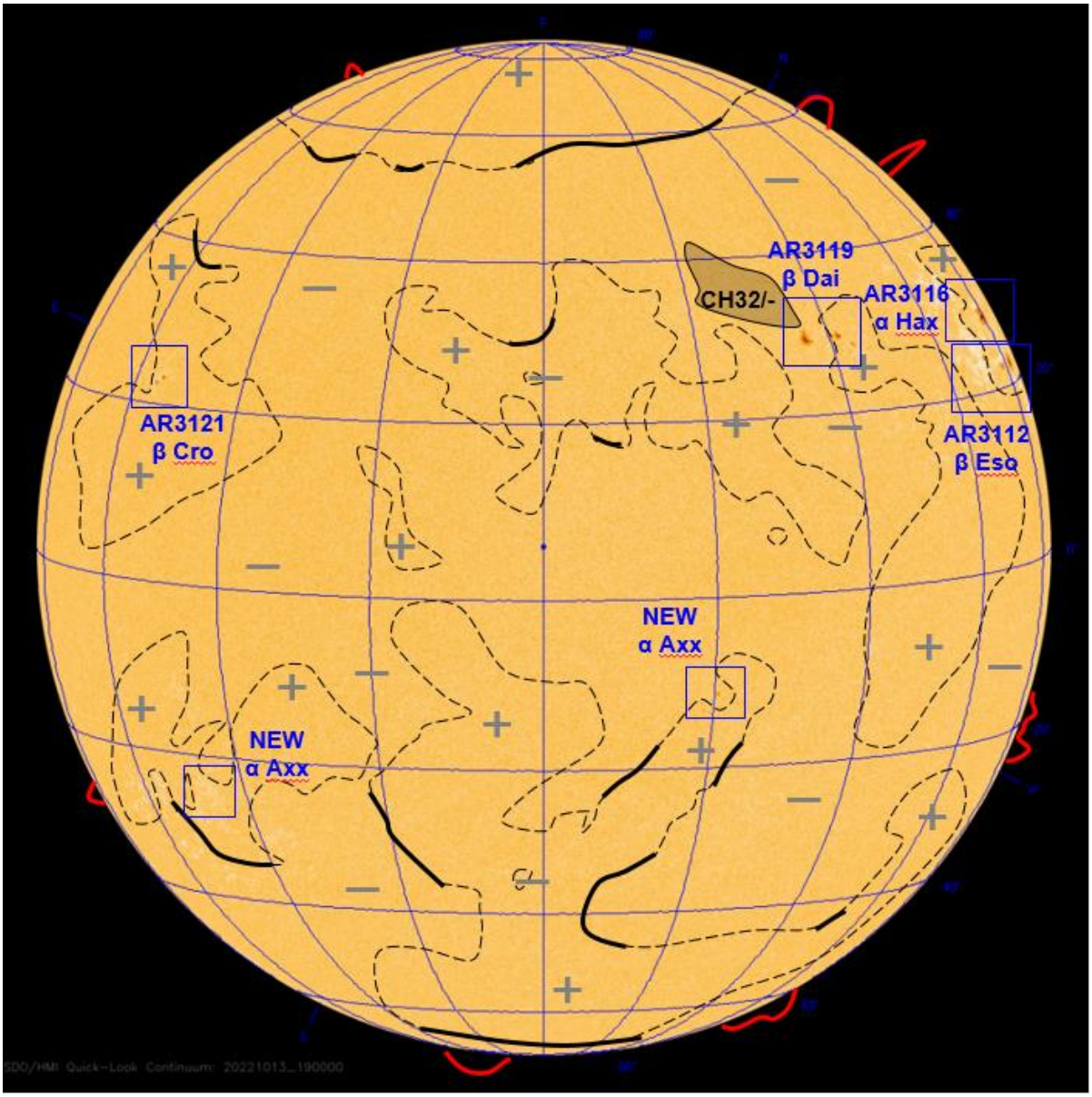
Met Office Space Weather Technical Forecast

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10MeV) is expected to be at background, but with a slight chance of rising in response to any large flares, primarily from the sunspots in the northwest quadrant. The high energy electron flux (greater than 2 MeV) is expected to be at Moderate to High levels, peaking with the diurnal cycles. The associated electron fluence is forecast to persist at Active levels, albeit with decreasing confidence, especially by day 4 (17th).

Figure 1. Solar Analysis Valid 13/1900 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

There is a weak CME, from a filament eruption on the 9th which is most likely to miss Earth, but may give a peripheral influence during day 2 (14th), and perhaps into day 3 (15th). A filament eruption from the southern centre disc early on the 13th has also produced a weak CME. Whilst the bulk of the material is likely to pass south of Earth's orbit, a glancing impact is possible towards the end of the period. However this has yet to be fully assessed for more exact timings of any arrival.

Solar winds are currently at background levels, with Earth embedded within an ambient slow wind environment. The next coronal hole fast wind enhancement is anticipated to be from CH32/- late day 2 or during day 3 (14th or 15th). Enlil has an earlier arrival through day 2, however this feature was larger in western extent on the previous rotation, and following persistence, this would be expected to arrive during day 3 (15th).

Predominantly Quiet geomagnetic activity is expected with isolated Unsettled intervals. There is the chance of isolated Active intervals with the fast wind arrival mainly late day 2 (14th) or day 3 (15th), or from any passing CMEs influence.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	5	10	5	10
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Figure 2: Met Office Enlil model which is offering poor guidance, with the high speed stream from CH32 too early, resulting in expected winds around 150 km/s too fast compared to current speeds.

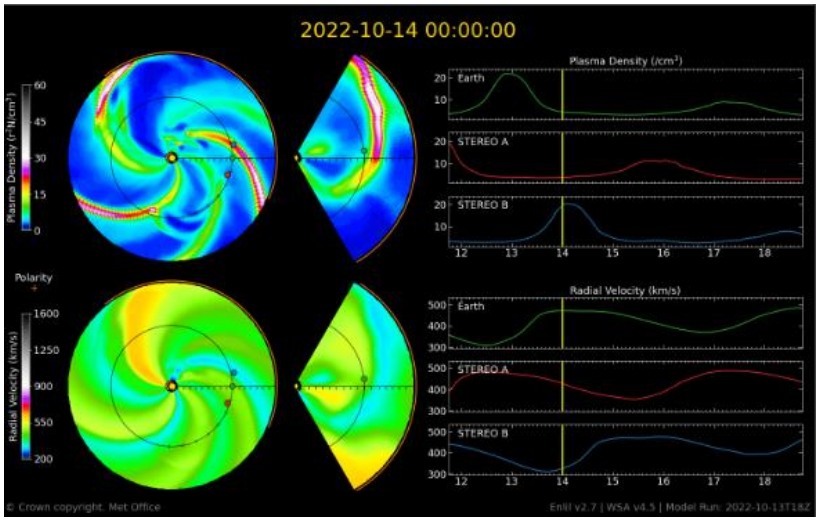

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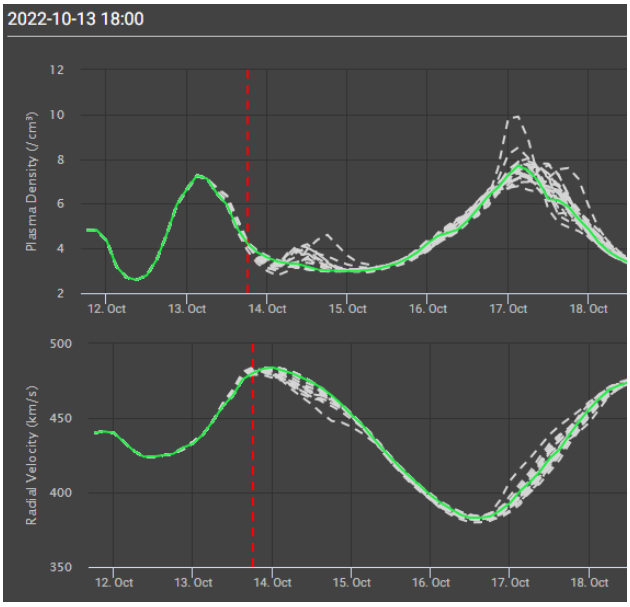
Figure 3: Met Office Enlil model ensembles, with indications of possible weak CME arrivals today and on the 17th.



Radio Blackouts - X-Ray Flares:

Activity has been Moderate but is expected to be mainly Low, with the source of the M1.5 flare early yesterday being AR3112 Eso/Beta which is now approaching the northwest limb. This sunspot has simplified over the past 24 hours, with some trailing spots fading, resulting into the reclassification as a smaller group. Despite this further M-class flares are still possible from this region.

AR3119 Dai/Beta produced a C4.7 flare during the past 24 hours, suggesting this also still has a small chance of producing low M-flares or similar. Further emergent flux regions towards the east limb remain relatively small and simple.
However, as Ar3112 will rotate off the visible disc later today or early tomorrow, the risk of M-class flares decreases through the forecast period. Also, no significant regions are expected to rotate onto the visible disc.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	Yes	25	15	5	1
Very Active	R3 to R5 X Class	No	1	1	1	1

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Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10MeV) as observed by GOES-16 is currently at background levels. Despite recent flaring over the last couple of days from AR3112, which is in a geoeffective location for proton storming, no observable increase in high energy proton flux has been observed. This sunspot continues to very gradually simplify, however due to its location and a couple of other active regions being present in the northwest disc, a very slight chance of approaching or exceeding the S1 threshold is maintained for the first two days.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	≥ S1	No	5	5	2	1
Very Active	≥ S3 *	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

High Energy Electrons Event (≥ 2MeV):

High energy electron flux (greater than 2MeV) as observed by GOES16 has been Moderate to High (above 1000 pfu). With no significant solar wind enhancement expected, and only the arrival of a weak HSS from CH32/- later today or tomorrow, then these levels are expected to persist for much of the period, albeit with peak flux levels declining. There is the potential for drop out later today or tomorrow from any HSS arrival or peripheral CME influence, however this is low confidence.

The associated 24 hour fluence is forecast to persist at Active (above 1e8 integrated pfu), at least during days 1 and 2 (14th and 15th), and potentially beyond. Any flux drop out later in the period may bring a chance of fluence levels falling below the Active level by day 4 (16th). The current REFM forecast is currently producing poor guidance, and so should be disregarded, although the REFM does show the potential for fluence values to gradually decline.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	≥ 2 MeV ≥ $1x10^8$	Yes	100	95	70	50
Very Active	≥ 2 MeV ≥ $1x10^9$	No	1	1	1	1

Figure 4: Met Office REFM model.

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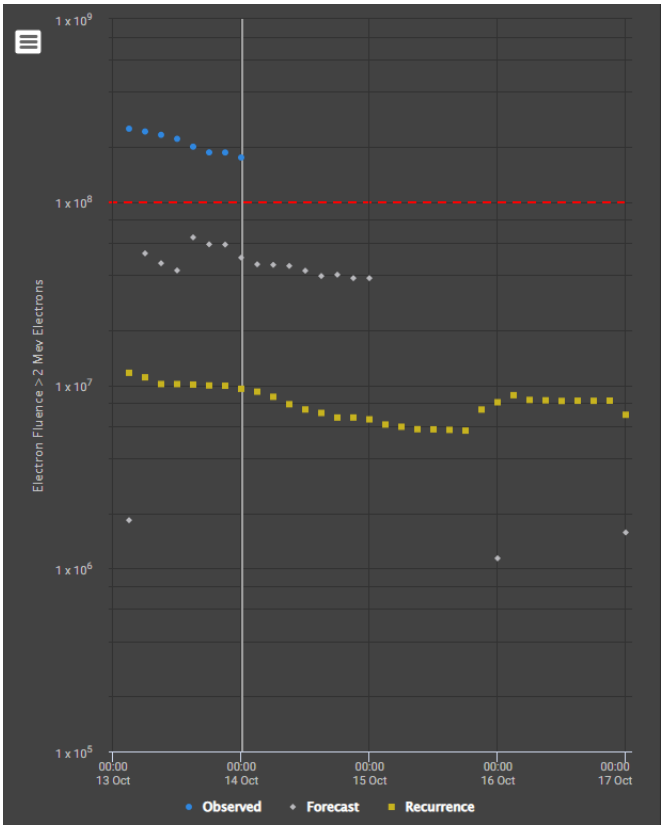

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